



UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER OF PATENTS AND TRADEMARKS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/982,144	10/19/2001	Hideo Nakagawa	740819-673	7544

22204 7590 06/03/2003

NIXON PEABODY, LLP
8180 GREENSBORO DRIVE
SUITE 800
MCLEAN, VA 22102

EXAMINER

ANDUJAR, LEONARDO

ART UNIT

PAPER NUMBER

2826

DATE MAILED: 06/03/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

09/982,144

Applicant(s)

NAKAGAWA ET AL.

Examiner

Leonardo Andújar

Art Unit

2826

-- The MAILING DATE of this communication appears on the cover sheet with the corresponding address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 17 March 2003.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-13 is/are pending in the application.
- 4a) Of the above claim(s) 8-11 is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-7, 12 and 13 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

NATHAN J. FLYNN
SUPERVISORY PATENT EXAMINER
TECHNOLOGY CENTER 2800

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on _____ is: a) ☐ approved b) ☐ disapproved by the Examiner.
If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

- 13) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☒ All b) ☐ Some * c) ☐ None of:
1. ☒ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
- a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

- 1) ☐ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____
- 4) ☐ Interview Summary (PTO-413) Paper No(s). _____
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: _____

DETAILED ACTION

Acknowledgment

1. The amendment filed on 03/17/2003, paper no. 7, has been entered. The present Office action is made with all the suggested amendments being fully considered. Accordingly, pending in this Office action are claims 1-13.

Election/Restrictions

2. Applicant's election without traverse of Group I (claims 1-7) in Paper No. 5 is acknowledged.

Priority

3. Acknowledgment is made of applicant's claim for foreign priority under 35 U.S.C. 119(a)-(d). Acknowledgment is made of applicant's claim for foreign priority based on an application filed in Japan on 10/26/2000. The certified copy of the priority document has been received.

Claim Rejections - 35 USC § 112

4. The following is a quotation of the first paragraph of 35 U.S.C. 112:

The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

5. The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention..

6. Claim 12 is rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the written description requirement. The claim(s) contains subject matter which was not described in the specification in such a way as to reasonably convey to one

skilled in the relevant art that the inventor(s), at the time the application was filed, had possession of the claimed invention. The specification does not contain any disclosure regarding a multi layer film that consists of two layers of said first metal film and said second metal film. According to the specification the multi layer film includes a barrier layer 104 between the first and second metal films. Therefore, the multi layer film cannot consist of only two layers.

7. Claim 1 is rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

8. Claim 1 recites the limitation "said second metal film contacted with a bottom of said via hole" in lines 9-10. There is insufficient antecedent basis for this limitation in the claim.

Claim Rejections - 35 USC § 103

9. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

10. Claims 1-7 are rejected under 35 U.S.C. 103(a) as being unpatentable over Kitch in view of Edelstein et al. (US 6,181,012).

11. Regarding claim 1, Kitch (e.g. 5) shows a semiconductor device comprising: metal interconnects (20, 22) made from a multi-layer film composed of a first metal film 25 deposited on a semiconductor substrate 10 with an insulating film 11 sandwiched

therebetween, an interlayer insulating film 30/32 formed on the metal interconnects, and a plug 28 made of a third metal film over the first metal layer within a via hole formed in the interlayer film. Also, Kitch disclose that copper can be used as a first and a third metal (col. 3/lis. 47-54). In this case a barrier layer is required. However, Kitch does not explicitly teach a seed layer or a second metal film between the first metal film and the third metal film. Therefore, Kitch does not disclose that the third metal film is deposited on the second metal film contacted with a bottom of the via hole. Edelstein discloses that copper based seed layers are used to improve the adhesion of copper to the barrier layers, electromigration resistant and other surface properties (col. 4/lis. 14-40). As shown in figure 3, the copper plug 46 is deposited over a seed layer 76/78 which contacts a bottom of the via hole. It would have been obvious to one of ordinary skill in the art at the time the invention was made to form the third metal film disclosed by Kitch over a seed layer contacting a via hole bottom surface in order to improve the electro migration resistant and other surface properties as taught by Edelstein. In regards to the process of making the third metal film, a "product by process" claim is directed to the product per se, no matter how actually made. See *In re Thorpe et al.*, 227 USPQ 964 (CAFC, 1985) and the related case law cited therein which makes it clear that it is the final product per se which must be determined in a "product by process" claim, and not the patentability of the process, and that, as here, an old or obvious product produced by a new method is not patentable as a product, whether claimed in "product by process" claims or not. As stated in Thorpe, even though product-by-process claims are limited by and defined by the process, determination of

patentability is based on the product itself. In re Brown, 459 F.2d 531, 535, 173 USPQ 685, 688 (CCPA 1972); In re Pilkington, 411 F.2d 1345, 1348, 162 USPQ 145, 147 (CCPA 1969); Buono v. Yankee Maid Dress Corp., 77 F.2d 274, 279, 26 USPQ 57, 61 (2d. Cir. 1935).

12. Regarding claim 2, Kitch in view of Edelstein shows a third metal film formed over the second metal film. In regards to the process of making the third metal film, a "product by process" claim is directed to the product per se, no matter how actually made. See In re Thorpe et al., 227 USPQ 964 (CAFC, 1985) and the related case law cited therein which makes it clear that it is the final product per se which must be determined in a "product by process" claim, and not the patentability of the process, and that, as here, an old or obvious product produced by a new method is not patentable as a product, whether claimed in "product by process" claims or not. As stated in Thorpe, even though product-by-process claims are limited by and defined by the process, determination of patentability is based on the product itself. In re Brown, 459 F.2d 531, 535, 173 USPQ 685, 688 (CCPA 1972); In re Pilkington, 411 F.2d 1345, 1348, 162 USPQ 145, 147 (CCPA 1969); Buono v. Yankee Maid Dress Corp., 77 F.2d 274, 279, 26 USPQ 57, 61 (2d. Cir. 1935). In any case, Edelstein teaches that copper can be deposited by many techniques including plating (col. 2/lis.45-65).

13. Regarding claim 3, Kitch discloses that the third metal film is made of copper (col. 3/lis. 47-54). Edelstein discloses that the main constituent of the seed layer is copper (col. 4/lis. 14-40).

14. Regarding claim 4, Kitch in view of Edelstein shows that the second and third metal films are made for copper as a principal constituent. Kitch in view of Edelstein does not use an adhesive layer between the second and third metal films. In regards to the process of making the third metal film, a "product by process" claim is directed to the product per se, no matter how actually made. See *In re Thorpe et al.*, 227 USPQ 964 (CAFC, 1985) and the related case law cited therein which makes it clear that it is the final product per se which must be determined in a "product by process" claim, and not the patentability of the process, and that, as here, an old or obvious product produced by a new method is not patentable as a product, whether claimed in "product by process" claims or not. As stated in *Thorpe*, even though product-by-process claims are limited by and defined by the process, determination of patentability is based on the product itself. *In re Brown*, 459 F.2d 531, 535, 173 USPQ 685, 688 (CCPA 1972); *In re Pilkington*, 411 F.2d 1345, 1348, 162 USPQ 145, 147 (CCPA 1969); *Buono v. Yankee Maid Dress Corp.*, 77 F.2d 274, 279, 26 USPQ 57, 61 (2d. Cir. 1935). In any case, Edelstein teaches that copper can be deposited by many techniques including plating (col. 2/lis.45-65).

15. Regarding claim 5, Kitch discloses an air gap 29 formed between the metal interconnections in the interlayer insulating film.

16. Regarding claim 6, Kitch in view of Edelstein shows a first and second metal, which inherently have resistance values. Kitch in view of Edelstein does not explicitly teach the resistant ratio of the interconnection layers. Nonetheless, it well known in the art those resistance ratios of the interconnection layers are subject to optimization. For

example, US 6,136,707 teaches that the requirement for providing a low resistance electrical path is fulfilled by choosing the seed layer to be comprised of an adequately thick, low resistivity material (col. 1/lls. 33-36). In this case, the specific ratio claimed by applicant, i.e., "wherein said first metal film composing said metal interconnect has interconnect resistant substantially $1/5$ /or less of interconnect resistance of said second metal film composing said metal interconnects", absent any criticality, is only considered to be the "optimum" resistant ratio of the metal interconnect layers disclosed by the Prior Art that a person having ordinary skill in the art would have been able to determine using routine experimentation based, among other things, on the desired accuracy, manufacturing costs, low resistance electrical path, etc. (see *In re Boesch*, 205 USPQ 215 (CCPA 1980)), and since neither non-obvious nor unexpected results, i.e., results which are different in kind and not in degree from the results of the prior art, will be obtained as long as the interconnection is used as already suggested by the Prior Art.

17. Regarding claim 7, Kitch in view of Edelstein shows a first and second metal, which inherently have resistance values. Kitch in view of Edelstein does not explicitly teach the resistance of the first metal layer is substantially equivalent to the resistance of the second layer. Nonetheless, it well known in the art that the resistance ratio of the interconnection layers is subject to optimization. For example, US 6,136,707 teaches that the requirement for providing a low resistance electrical path is fulfilled by choosing the seed layer to be comprised of an adequately thick, low resistivity material (col. 1/lls. 33-36). In this case, the specific resistance claimed by applicant, i.e., "wherein said first metal film composing said metal interconnect has interconnect resistant substantially

equivalent to interconnect resistance of said second metal film composing said metal interconnects", absent any criticality, is only considered to be the "optimum" resistant ratio of the metal interconnect layers disclosed by the Prior Art that a person having ordinary skill in the art would have been able to determine using routine experimentation based, among other things, on the desired accuracy, manufacturing costs, low resistance electrical path, etc. (see *In re Boesch*, 205 USPQ 215 (CCPA 1980)), and since neither non-obvious nor unexpected results, i.e., results which are different in kind and not in degree from the results of the prior art, will be obtained as long as the interconnection is used as already suggested by the Prior Art.

18. Regarding claim 12 (as understood), Kitch in view of Edelstein discloses that the multi layer film comprises a first metal film 25 and a second metal film (seed layer).

19. Regarding claim 13, Kitch shows that the air gap is substantially equal to the space between the metal interconnects.

Response to Arguments

20. In response to applicant's arguments against the references individually, one cannot show nonobviousness by attacking references individually where the rejections are based on combinations of references. See *In re Keller*, 642 F.2d 413, 208 USPQ 871 (CCPA 1981); *In re Merck & Co.*, 800 F.2d 1091, 231 USPQ 375 (Fed. Cir. 1986).

21. Applicant argues that Kitch invention is different from the claimed invention because the insulating layer of Kitch is made from two dielectric materials. Nonetheless, the claim does not specify that the insulating layer has to be made of a

single material. Although the claims are interpreted in light of the specification, limitations from the specification are not read into the claims. See *In re Van Geuns*, 988 F.2d 1181, 26 USPQ2d 1057 (Fed. Cir. 1993).

22. Applicant argues that unlike Edelstein which require the seed layer to be formed on the barrier layer, there is not seed layer on a barrier layer is included in the presently claimed invention. Nonetheless, the claim does not specify that third metal film has to be in direct or in physical contact with the seed layer. Although the plug of Edelstein is not in direct contact with the bottom of the via hole they are in contact (i.e. electrical contact). Although the claims are interpreted in light of the specification, limitations from the specification are not read into the claims. See *In re Van Geuns*, 988 F.2d 1181, 26 USPQ2d 1057 (Fed. Cir. 1993).

23. In response to applicant's argument that there is no suggestion to combine the references, the examiner recognizes that obviousness can only be established by combining or modifying the teachings of the prior art to produce the claimed invention where there is some teaching, suggestion, or motivation to do so found either in the references themselves or in the knowledge generally available to one of ordinary skill in the art. See *In re Fine*, 837 F.2d 1071, 5 USPQ2d 1596 (Fed. Cir. 1988) and *In re Jones*, 958 F.2d 347, 21 USPQ2d 1941 (Fed. Cir. 1992). In this case, Kitch (e.g. fig. 5) shows a third metal film 28 formed on a first metal film 25 whereas Edelstein (e.g. fig. 2) teaches a barrier/seed layer 76/72 between two metal layers (56, 46). Also, Edelstein discloses that copper based seed layers are used to improve the adhesion of copper to the barrier layers, electromigration resistant and other surface properties (col. 4/lis. 14-

40). It would have been obvious to one of ordinary skill in the art at the time the invention was made to form the third metal film disclosed by Kitch over a seed layer contacting a via hole bottom surface in order to improve the electro migration resistant and other surface properties as taught by Edelstein.

Conclusion

24. **THIS ACTION IS MADE FINAL.** Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a). A shortened statutory period for reply to this final action is set to expire **THREE MONTHS** from the mailing date of this action. In the event a first reply is filed within **TWO MONTHS** of the mailing date of this final action and the advisory action is not mailed until after the end of the **THREE-MONTH** shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than **SIX MONTHS** from the mailing date of this final action.

25. Papers related to this application may be submitted directly to Art Unit 2826 by facsimile transmission. Papers should be faxed to Art Unit 2826 via the Art Unit 2826 Fax Center located in Crystal Plaza 4, room 3C23. The faxing of such papers must conform to the notice published in the Official Gazette, 1096 OG 30 (15 November 1989). The Art Unit 2826 Fax Center number is **(703) 308-7722** or **-7724**. The Art Unit 2826 Fax Center is to be used only for papers related to Art Unit 2826 applications.

Art Unit: 2826

26. Any inquiry concerning this communication or earlier communications from the examiner should be directed to **Leonardo Andújar** at **(703) 308-0080** and between the hours of 9:00 AM to 7:30 PM (Eastern Standard Time) Monday through Thursday or by e-mail via Leonardo.Andujar@uspto.gov. If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nathan Flynn, can be reached on (703) 308-6601.

27. Any inquiry of a general nature or relating to the status of this application should be directed to the **Group 2800 Receptionist** at **(703) 305-3900**.

28. The following list is the Examiner's field of search for the present Office Action:

Field of Search	Date
U.S. Class / Subclass (es): 257/678, 773, 774, 775; 438/618, 622,625	05/03
Other Documentation:	
Electronic Database(s): East (USPAT, US PGPUB, JPO, EPO, Derwent, IBM TDB)	05/03

Leonardo Andújar

Patent Examiner Art Unit 2826

LA
5/29/03